CHAPER- 5

DISCUSSION

Distribution of soil fungi

From table No. 1, it is evident that soil of grape and *Citrus* gardens show a large number of fungal species. Forty seven species of fungi are isolated from which 19 species are common to the four soils. Rao (1988) recorded a number of soil borne plant pathogens such as *Fusarium oxysporum, Curvularia lunata, Penicillium Spp., Nigrospora sphaerica Aspergillus flavus, Aspergillus fumigatus, Aspergillus terreus,* and *Aspergillus candidus.*

Garrett (1951) defined the ecological group of soil fungi as some peculiar advantage characterizes assemblage of species for pioneer colonization of a peculiar substrate and divided into few larger groups. These groups are, the root inhibiting fungi, the lignin decomposing fungi, the saprophytic fungi, the predaceous fungi and the coprophilous fungi. In the presence of bacterial and fungal antagonists, Park (1957- a) made a study on the behaviour of soil fungi on the basis of their ecological relationships. They are classified as the fungi adapted to continued activity in the soil substances and the fungi, which are less adapted.

An ecological classification of Garrett (1951) Phycomycotina includes saprophytic fungi; cellulose-decomposing fungi included in Acscomycotina and Basidiomycotina, fungi imperfecti includes lignin decomposing fungi. The present work shows the fungi isolated from soil belonging to 20 genera and 48 species. Of these, 3 species from Phycomycotina, 1 species belongs to Ascomycotina and 12 species are included under Deteuromycotina. Basidiomycotina were not found in any type of soil. This shows that, Deteuromycotina members were more dominant.

There is much variation in the opinion regarding the fungal species present in different soils. While considering the soil diversity, it is not surprising. Werkenthin (1916) and Brierly (1923) studied the fungi from cultivated and uncultivated soils. They were not found much different in fungi from these soils. Jensen (1931) observed that *Penicillia* and *Trichoderma* were common in acidic soils. Mucorales were dominant in field and garden soils. While *Fusarium* and *Phoma* were abundant in cultivated soils. In field and garden soils Mucorales were dominant and *Fusarium* and *Phoma* were found in cultivated soils. In cultivated soils Campbell (1938) found more species of Mucorales and in peat bog soils less number of Mucorales was observed. Mucorales has no specific

distribution in different soil types. A widely represented fungal flora containing Mucorineae which is associated with the soils, which are rich in organic matter, were found by Nicot (1953) in tropical Africa and in Madagaskar, which were *Penicillium* and *Aspergillus* Spp. *Trichoderma viride, Cladosporium herbarum* and *Gliocladium roseum* in some soils under large scale cultivation. Ordin (1957) observed that uncultivated black soil and forests were characterized by a large number of *Penicillia* and few species of *Trichoderma, Mucor, Rhizopus, Fusarium, Cladosporium, Phoma* and *Chaetomium* were dominant in the steppe soil. Miller et al; (1957) observed that in cultivated fields, the chief genus was *Aspergillus*, while in forest soils, *Penicillium* was dominant. Singh (1947) isolated two species of *Dictyostelium* from soils of Rothamsted in which no fertilizers or only artificial ones has been applied for over hundred years and disproved that *Dictyostelium* were dung organisms. Misra (1986) found that species of *Aspergillus* were dominant in mud, which is followed by *Penicillium* by screening of fungi from root region of Soybean. Chesters (1949) and Burges (1958) observed that more frequent genus in soils of warm climate was *Aspergillus* than *Penicillium*. Various workers such as Stover (1959), Ghosh and Dutta (1960), Das (1963), Agnihotri (1964), Dutta and Ghosh (1965) and Kamal and Bhargava (1970) reported that *Aspergillus* and *Penicillium* were found to dominate.

Regarding the occurrence of *Fusarium*, many workers have expressed their views. In order of preference, Bisby et al (1935) put *Fusarium* species in second number, but it was put in last number by Waksman (1916). The species of *Fusarium* were found abundant by Swift (1929). The species of Fusarium were found very common in cultivated soil while rare in forest soil by Miller et al (1957). Christensen et al (1962) observed that, it is prominent in population from soil of Wisconsin. Thornton (1958) observed that, *Fusarium* sp. were absent in Oak wood forest and heat acid soil. Jeffery et al (1953) also observed absence of *Fusarium* in heat acid soil, but McLennan and Ducker (1954) were found *Fusarium* spp. in heat acid soil. Park (1963) observed and isolated *Fusarium oxysporum* from grassland but it was absent in forest soil. In Hongkong Chou and Stephen (1968) isolated *Fusarium* sp. as a rare one. Christensen et al; (1962) found *Cladosporium* sp in all seasons very frequently.

In the present study the commonest fungi are *Aspergillus, Fusarium, Trichoderma, Curvularia, Memnoniella and Bipolaris.* The order of occurrence of dominant genera was *Aspergillus, Fusarium, Trichoderma, Bipolaris, Memnoniella and Curvularia.*

The soils of grape and *Citrus* garden show a variety of mycoflora such as *Rhizopus, Mucor, Cunninghamella, Ttrichoderma, Aspergillus, Peinicillium, Cladosporium, Curvularia, Alternaria, Fusarium, Bipolaris, Memnoniella, Brachysporium* and *Stachybotrys.* Ecologically significant distribution of a particular genera and species was not exhibited. Some species were restricted to a particular soil. Some species show irregular distribution. This may be possible because few genera and species show progressive appearance or disappearance from soil to soil.

Types of soil selected:

In the present study, four types of soils were selected. Soil sample 'A' was black soil from *Citrus* garden, soil sample'B' was red soil from another *Citrus* garden. Soil 'C' was selected from grape garden having red soil and soil sample 'D' was black soil from another garden of grape. The red soil of *Citrus* garden is rich in mycoflora than black soil of another *Citrus* garden. The red soil of grape garden is rich in mycoflora than black soil, which indicates that the red soil is more fertile than black soil of both the gardens.

A different relation between the fertility of soil and number of fungi was observed by Singh (1937). Jasevoli (1924) studied that the number of fungi and he showed that higher number of fungi found on the soil surface, while it decreases with the depth. But Deka and Mishra (1984) reported that the composition of fungal species was not influenced by the soil depth, by studying the distribution of microflora of soil in Jhum follows. According to Cooke (1948), to understand the ecology of soil microflora, the correlation between fungus flora of soil and soil type is valuable.

Mujumdar and Deoray (1968) counted the microorganisms in black soil of Baramati grassland. They also studied red soil from the coastal region of Ratnagiri from the vicinity pneumatophores of *Rhizophora mucronata.* The maximum number of microorganisms was observed in black soil than in saline soil. Rao (1970) investigated

that the greater number of fungi in garden soil was because of the most fertile, dark brown colour of soil. The black colour of soil in maize soil was because of the good tillage and better aeration. The uncultivated soil shows lowest number of fungi because it was less fertile and dark brown in colour. The forest soils are more fertile due to luxuriant vegetation and decaying matter. Therefore the variation in number of fungi in forest and maize field soil was not significant, while a marked variation in garden and uncultivated soil.

With regards to the number of species and total number of fungi, the fungal flora of desert soil was poor, which was observed by Ismail and Abdullah (1977). But the number of fungal species with their total number increases in soils under active cultivation. Mukerji (1984) observed that the riverbed soil shows less number of fungi while forest soil shows highest number of fungi. Sawant (1984) studied the fungal flora of garden soil and reported that the large number of fungi was found in it because of most fertile garden soil. She also studied the soil of guava field and reported that, the red soil shows large number of fungi than the black soil. The uncultivated soil shows less number of fungal populations, as it was less fertile.

Plant cover:

The present study shows difference in their plant cover. Both are the perennial plants. Good growth of different weeds was observed in grape garden soil. There was constant growth of different weeds. These soil types show slight variation in their plant cover, which causes variation in the mycoflora of soil.

Many workers reported the importance of plant cover that influences fungal population in soil. Christensen et al (1962); Orput and Curtis (1957), Trenser et al (1954) reported that soil microfungi do not form discrete communities, but rather Continua. Curtis (1957) described similar reports to those of higher plants. The continua contains the series of continuously changing species combinations among the sites samples, the vegetational continua appear to be correlated with the microfungal continua. The soil microflora is influenced by that vegetation.

Four soils differed in their plant cover were studied by Rao (1970). He observed that, good growth of large trees and shrubs was in deciduous forest, throughout

the year. The cultivated soil has shown the crop of maize during monsoon that is from July to November and the annual weeds were grown during follow period. While flowering plants were grown in garden soils, throughout the year, different seasonal weeds along with shrubs were grown in uncultivated soils. From the data, it is significant that, the higher number of fungi showing months correspond with the maize crop in cultivated soil, and with luxuriant growth of vegetation in forest and uncultivated soils. Ismail and Abdullah (1977) observed maximum number of species from cultivated soils from Zubair and Abdul Khashib. While, from date palm plantation, the minimum number of species were observed. From uncultivated soil, Megharaj et al (1987) reported the maximum number of fungi and from Subabul field minimum number of fungal species were observed. Sawant (1984) observed the variation in the fungal flora from garden soil, soil of Guava field and uncultivated soil was because of variation in their plant cover.

Soil Moisture:

In the present investigation, the moisture percentage of four soils from four different gardens was measured throughout the year. The moisture percentage of four soils was between 15% to 28%. The lowest moisture percentage was observed in soil sample 'A' in the months of January, May and November and in soil sample 'B', it was in September. The highest moisture percentage was observed in soil 'B' in April.

Moisture content has direct correlation with the fungal numbers, which was investigated by many workers such as Dixon (1928), Jasevoli (1924), Trensr et al (1954), Waksman (1944). But Cobb (1932) and Ramakrishnan (1955) were not observed such a correlation in other soils. Stover (1953) observed that the population of *Fusarium* species might be greatly reduced because of maintenance of soil in a saturated condition in absence of hosts. Menon and Williams (1957) found that the maximum number of fungal flora in low moisture than higher moisture level.

Orpurt and Curtis (1957) investigated the fungal population of some prairies in U.S.A. which ranged from very wet to very dry. They observed that there were no difference in the fungal flora. But different fungi were more abundant and others were less frequent at different moisture levels of the prairies. Rao (1970) studied the correlation between soil moisture and abundance of fungi in soil. For that, garden soil,

maize field, forest soil and the uncultivated soils were selected. Higher moisture was observed in maize field soil, which is followed, by forest soil and the minimum moisture was observed in uncultivated soils. The fungal number was decreased with decrease in moisture level. In case of garden and forest soils, the correlation between fungal number and moisture content of soil was clearly observed. While the maize field and uncultivated soils did not show any significant correlation. Moubasher and El-dohlob (1970) observed in Egypt that, the period of April, September and October and November shows maximum fungal number as the period shows relatively moderate water content and temperature. While in summer, the fungal number was minimum because of unfavourable conditions as the soil was rather dry. The direct correlation between number of soil fungi and soil moisture was studied by Ismail and Abdullah (1977). Behera and Mukerji (1984) observed that in various seasons, the soil moisture was responsible for fungal distribution. Maximum moisture content is observed during rainy season which shows maximum number of fungi in the soil.

Soil reaction:

In the present investigation, P^H of four soils was determined. The P^H of four soils was between 7.0 to 8.8. The lowest P^H that is 7.0 was observed in soil sample 'A' in November and in soil sample'D' in December. While the highest P^H that is 8.8 was observed only in soil 'A' in May. There was no effect of P^H on the fungal flora of soil.

Fungi prevail in acid soil while bacteria in neutral and alkaline soil, which was stated by Ramann et al (1899). This was supported by Leclerg (1931), Shetye (1954) and Waksman (1944), while Cobb (1932), Eggleton (1938) differed from this. Jensen (1931) reported that fungi were dominant in acidic soils because bacteria show less growth in acidic soils hence there is elimination of competition with bacteria. Warcup (1950) stated that, when condition changes from alkalinity to acidity, there is increase in number of fungi per gram of soil.

Saksena (1955) reported that not only P^H of the soil affect the number of fungi in soil but also other factors such as moisture content and organic acids affect the microbial population.

Rao (1970) observed highest number of fungi in alkaline soil of garden while less number of fungi was observed in uncultivated soil that was comparatively less alkaline. On the other hand, the soil of maize field having low P^H showed the maximum number of fungi in September. From this it is clear that, not only P^H is the limiting factor but there is also a possibility of other nutrients. Under the study of correlation between the variation in P^H and fluctuation in fungal numbers an inverse correlation was observed in garden soil. From this, he concluded that, both acid and alkaline soil support large number of fungi and an inverse influence on the abundance of fungi were exerted by small fluctuation in P^H within each soil. Menon and Williams (1957), Ismail and Abdullah (1977), Moubasher and Abdel- Hafez (1978) observed that, mycoflora was not influnced by the P^H on soils. Kale (1981) made a study on mycoflora of soil of Bombay – Pune tract and reported that, the fungal population per gram of soil increases as the condition changes from alkalinity to acidity. The less number of fungi was observed in alkaline soil of Bombay and Panvel as compared to the acidic soil of the ghats and the plains of Maharashtra. Salvi (1983) and Sawant (1984) observed that, the fungal flora of soil has no effect of P^H and it remains constant.

Iron and Magnesium:

In the present investigation, the iron content of four soils was between 0.8 % to 1.90%. The lowest iron content was observed in soil sample 'B' in March and the highest content was observed in soil sample'D' in October and December. The lowest magnesium that is 4.57% was observed in soil sample 'B' in April. The magnesium content in four soils was between 4.57% to 11.52%.

A direct correlation existed between exchangeable iron and number of fungi observed by Rao (1970) in all the four soils studied. Sawant (1984) studied a correlation between exchangeable iron and fungal numbers from garden soil, uncultivated soil and Guava field soil.

Manganese, Copper and Zinc: -

The percentage of manganese, copper and Zinc was recorded from four different soils, The manganese content in four soils is between 0.010%to 0.055%. The lowest

percentage of manganese was recorded in soil sample 'B' in February while the highest percentage of manganese was recorded in soil sample 'A' in the months of January, July and August and in soil sample 'B' in June. The lowest percentage of copper was recorded in soil sample 'B' in October while highest percentage was recorded in soil sample 'B' in July and in soil sample 'C' in June. The copper percentage in four soils was between 0.01 to 0.03%.

Rao (1970) studied inverse correlation between manganese and number of fungi in maize field, garden and uncultivated soils. A positive correlation between exchangeable manganese and fungal number was observed in forest soil. By application of manganese sulphate at the rate of 40 pounds, Marsh and Bollen (1943) observed that, the number of moulds doubles in Williamette silty clay loam in five day and decreased in Newbery loamy sand, especially after 30 days when 100 pounds of manganese sulphate was applied. From this, they concluded that the soil microflora was responding inverse proportion to available manganese. An inverse correlation between manganese and fungal number of garden soil, guava field and uncultivated soils was observed by Sawant (1984).

Seasonal variation in fungal numbers: -

Seasonal variation in number of fungi was studied by Ma (1933), Cobb (1932) and Stevenson and Chase (1957). Seasonal; changes were not observed by Singh (1937)& Sewell (1959). Brierly (1923), England and Rice (1957), Pugh (1957), Witkamp (1960), Reddy (1962), Fincher (1963), Suprun (1963), Gams and Domsch (1969) and several others studied seasonal fluctuation of fungi. They reported the seasonal variation in the composition of the fungal flora. More fungi were recorded in September by Timonin (1935). During winter and spring Trenser (1954) found greater number of microorganisms in soil.

Warcup (1957) observed that, in summer the number of fungi were less because of low soil moisture. Saksena and Sarbhoy (1962), observed that, the number of fungal colonies were less in number during summer than rainy season or winter. According to Saksena, less number of fungal colonies was because of persistentdrought and high temperature.

Mujumdar (1966) observed that, a large number of fungal colonies in cultivated soils during the summer was because of irrigation and addition of fertilizers. Moubasher and Eh- dohlob (1970) observed seasonal variation of soil fungi of nineteen months. They observed that the period between November and April and between September and October, shows rich mycoflora. In these periods, the average maximum temperature between 19°c and 35°c and the average minimum temperature between 7°c and 22°c. Brierly (1923), England and Rice (1957), Warcup (1957) and Witkamp (1960) were observed a similar observation. During the experiment, Moubasher and El- dohlob (1970) isolated sixteen genera in addition to members of Mucoraceae. They isolated *Aspergillus, Penicillium* and *Fusarium* throughout the year. During the summer season, *Aspergillus* showed the less frequency of occurrence. The frequency of *Aspergillus* was affected, when the field left unplanted and dry. On the other hand, the soil of field was milder because, the fields were cultivated with cotton and periodically irrigated. The highest and least frequency of *Penicillium* was observed in summer months. Reddy (1962) observed that, the high altitudes of the Nilgiri forest in India suppressed *Aspergillus.* Moubasher and El- dohlob (1970) observed that, the regular response to fluctuation of seasonal condition was not shown by *Fusarium* and during June- July, it showed predominance over all the soil fungi. June- July were the severest months of their experimental period. During summer months, *Fusarium* was isolated in moderate frequency. This may shows that *Fusarium* is thermotolerent.

Tolba (1952) and Taloba and moubasher (1957) observed that during summer months *Fusarium* showed high prevalence among the fungi recorded from damped off seedling of lettuce and cotton.

Rao (1970) observed that the months, viz; March, April, May and June show lowest number of fungi while September shows highest number of fungi with the exception of forest soil. This month showed the maximum frequency in October. There is little fluctuation in number from October to February. During hot season in March, there was sudden fall observed in all the soils. During study the survey of Mahabaleshwar, Ursekar observed that summer season was not favourable for growth of fungi. Eggleton (1938) and Miller et al; (1957) observed that the environmental factors such as

temperature, rainfall, humidity etc. control the amount of energy material available from the soil which reaches to the soil microorganisms.

The highest number of fungi was observed in January, March, May, June, July, August and November. While, lowest number was observed in December, February, April, September and October in *Citrus* gardens.

In the present investigation, the months of January, February, April, July, October, November and December show highest number. While lowest number was observed in March, May, June, August and September in grape gardens.

Aspergillus niger, Aspergillus ustus, and *Fusarium poae* were dominant in all seasons in the soils of *Citrus* and grape gardens.